IMSA
Illinois Mathematics and Science Academy

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Chewing Gum Challenge – 7 years to digest?

Activity Time: Day 1 – 60-75 minutes
Day 2 – Observations every 6 hours

SUGGESTED GRADE LEVELS: 3rd grade and up

SAFETY INFORMATION : Adults be sure to supervise while the kids are chewing on the gum

SUMMARY OF ACTIVITIES

- Day 1: Set up experiment – will our stomach digest gum?
- Day 2: Make observations based on the results of the experiment from Day 1

IMPORTANT INFO TO KNOW

We've all been there; chewing a wad of gum when all of the sudden, GULP! We swallowed it!! The fear; the dread of what's to happen – we just know it's bad because we were told NEVER to swallow our gum! 'But, Why?' we'd ask, curiously. Well, it's because it takes 7-years to digest, of course! Nobody wants anything in their body for 7-years; especially a wad of chewing gum! But, to what degree does this logic hold truth? Has science put it to the test? In order to understand what's happening in our bodies, we need to know a little bit about digestion and a little chemistry.

First, digestion begins in the mouth with two processes: 1. mostly mechanical digestion (physical breakdown of food, via chewing) and 2. Some chemical digestion (there are chemicals called enzymes in your saliva which begin to break-down some parts of the gum). Then, if whatever you have chewed gets swallowed, it travels down the esophagus to the stomach, where chemical digestion is prominent, with a little bit of mechanical digestion (via muscle contractions which churn the food).

In the stomach, the chemical digestion is primarily performed by a substance called stomach acid, with a low pH value of about 2. In addition to the acidic environment there are more enzymes in the stomach which continue to break-down digestible substances that are consumed. So basically, mechanical and chemical digestion allows for the body to efficiently extract components of the swallowed food for use by the body; these extracted components from the food we eat are then converted into energy or some other useable entity from which our body could benefit. However, many of the foods/items we consume have parts that are indigestible (not broken-down inside the body); these parts of our food pass through the stomach, into the intestines and eventually proceed out the other end of our bodies. Anything that is indigestible, or that the body doesn't use, simply passes out of the body as solid waste. So, where does gum fit in? Chewing gum typically is made of a few ingredients including: gum base, sweetener, flavoring, preservatives and a softener. Gum was originally made from the sap of the sapodilla tree, but today gum manufacturers use a variety of synthetic elastic (stretchy) substances to make the gum base for their gum; each manufacturer uses their own combination of ingredients with the intention of getting the best amount of elasticity (chewiness).

DAY ONE

ACTIVITY ONE (25 – 50 mins.)

MATERIALS

1 – sheet of chart or graph paper
1 – stopwatch
4 – pieces of gum, from four different brands
Dot stickers, four different colors
Colored pencils, same color as dot stickers

WHAT TO DO

1. First we want to find out which brand of gum has the longest lasting flavor! How can we test this?
2. One way is to use the stopwatch to record the time from when you first start chewing on the gum until the second there is no flavor left. Let's get our graph ready so we can record our data as we experiment! Don't forget to include a key somewhere on the graph, and assign each brand of gum a different color dot sticker
    - For our graph, the x-axis will be the time intervals, starting at 0 and adding a data point every two minutes until 10 minutes.
    - For our graph, label the y-axis 1 through 5. This will be our gum flavor rating scale
3. Every two minutes, the gum chewer will rate the flavor left in the gum. Each brand of gum will start at 5 when the time is 0. 1=least flavorful, 5=most flavorful (initial taste)
4. For each brand of gum, collect data until the gum has lost flavor or 10 minutes have passed. Look at your key to see which brand of gum is assigned to which color of dot sticker.
5. It's time to collect our data! Start by placing the dot sticker corresponding to the gum chewed first at 5 on the y-axis and 0 on the x-axis. Have your stickers ready to put on the graph every two minutes! You will chew and record your data at the same time. One person records the time, and the other person/s chews the gum. If you have more than one person, you can test more than one brand at a time.
6. Start the stopwatch as soon as the gum goes into the mouth, and call out every two minutes. Stop recording as soon as the person chewing says there is no flavor left, or 10 minutes have passed.
7. Repeat steps 4 and 5 until all of the gum brands have been tested.
8. Don't throw away your chewed gum yet! Set it on the wrapper.
9. The brands that lost flavor completely are at the stage where all that is left is the gum base, which our mouths

OPPORTUNITY FOR INQUIRY

Talk through different experiment options, this will help guide how you make your flavor graph and collect data.

TIPS FOR FACILITATORS

If your child isn't sure how to make a graph, talk through the part required to make one. Our graph needs two axes, one along the bottom of the paper and one going vertically up the paper. The horizontal line, the x-axis, shows us the variables that stay the same. The vertical line, the y-axis, is where we record the different data we find.

OPPORTUNITY FOR INQUIRY

Do you think how fast you chew the gum will matter? If more than one person is participating, and each is chewing a different brand, how might that affect our data?

We know there are two types of digestion used by the mouth – chemical and mechanical. Which one does the physical chewing represent? Mechanical! Then what part was chemical? The saliva!

cannot digest. But can our stomachs? Now we will set up the experiment to see if our stomachs can digest gum, or if it stays in for 7-years!

WHAT'S HAPPENING

Which brand seemed to lose its flavor the fastest? Talk about the shape of the 'lines' made by the dots on the graph – which "line" tells us the gum that had the longest lasting flavor (the top one/least steepest set of dots). Discuss why we used the one that lost its flavor, because we know that all that is left is the gum base. What kind of digestion happened in the mouth? (both mechanical and chemical). The goal in the next activity is to model how the stomach also does mechanical and chemical digestion. Pose the question: can the stomach break-down the gum? Do you think gum would stay in the stomach for 7-years?

ACTIVITY TWO (15 mins.)

MATERIALS

1 – 1-2" piece of sandwich bread
1 – piece of unchewed gum, from the brand that lost flavor first in Activity 1
1 – piece of partially chewed gum, from the brand that lost flavor first in Activity 1
1 – piece of completely chewed from, from the brand that lost flavor first in Activity 1 (you can use the piece already chewed)
4 – quart-size Ziploc bags
2 – cups of vinegar
1 – ½ c. liquid measuring cup
1 – permanent marker

WHAT TO DO

1. While we can't test the 7-year claim (because we don't' have 7 years available) we CAN test whether or not gum will digest in the stomach when compared to stuff that we know will digest (bread).
2. Let's set up our experiment! Label the four plastic bags
   - Completely Chewed
   - Partially Chewed
   - Unchewed
   - Bread
3. Place the unchewed gum, completely chewed gum, and bread in the correctly labeled bags.
4. How can we get the partially chewed gum? Once the gum is partially chewed, place it in the last labeled bag.
5. Not add ½ c. vinegar to each bag, and close tightly to make sure no liquid leaks out. The vinegar can be used to represent our stomach acid. Why would we use vinegar?
6. Once the vinegar has been added to all the bags, massage the gum or bread as it floats in the vinegar. Do this for 15 seconds.
7. Set the four bags somewhere to sit overnight, making sure the gum or bread is submerged in the vinegar. Let

OPPORTUNITY FOR INQUIRY

The partially chewed gum should be chewed for half the time it takes the gum to lose all flavor – if it took four minutes to lose flavor, chew a new piece of gum for two minutes

The pH of our stomach acid, or how acidic our stomach is, ranges from 1.5 – 3.5. The pH of vinegar is 2.5, so it is the same level of acidity. The stomach's acidity is what breaks down the food.

OPPORTUNITY FOR INQUIRT

Just like the mouth, the stomach uses two types of digestion. What does the vinegar

your experiment sit until tomorrow! What do you think we will find tomorrow?

represent? Chemical digestion! What does the massaging represent? Mechanical digestion!

WHAT'S HAPPENING

What is the difference between chemical and mechanical digestion? Mechanical is a physical process, chemical involves some reaction or break-down at the molecular level. How did we perform these? (chewing gum is both mechanical and chemical). In the first activity, chewing gum didn't model digestion, but rather it demonstrated digestion, which begins in the mouth. In the second activity chemical digestion is being modeled by the pH of the vinegar (modeling low pH of stomach acid) while mechanical digestion was modeled by massaging the contents of the bags containing the vinegar and gum.

DAY TWO

ACTIVITY THREE

MATERIALS

Gum and bread soaking in vinegar from Day One, Activity Two

WHAT TO DO

1. Depending on when the gum and bread were put in the vinegar, observations can start being made the same day.
2. If possible, start checking on your gum and bread soaking in the vinegar after six hours, and continue to write down observations every six hours. Don't worry, you don't have to check while you are sleeping!
3. After 24 hours, note final observations. Did the "stomach acid" vinegar break down the gum? Yes! The results of our experiment show that the stomach can break down gum.
4. So does gum stay in the stomach for 7 years? No it does not!! It will get broken down and digested, or passed out as solid waste in a matter of hours
5.

OPPORTUNITY FOR INQUIRY

What does the gum and bread look like? Has the texture changed? If you squish it in the bag, does it feel different or does it break up and fall apart?

WHAT'S HAPPENING

Everyone needs to digest things we swallow - but does everything get digested? (no; indigestible substances pass out the other end as solid waste – mostly this includes fiber from fresh fruits and vegetables but could include indigestible gum too.)

So, will gum really stay in your system for 7-years? (No; it takes about 6-8 hours for food to leave the stomach and enter the small intestines. On average foods take 24-35 hours to be completely digested but this varies with the type of food and the individual; the gum would be passed out other end with other indigestible food components).

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MATERIALS

ITEM NAME	DESCRIPTION	AMOUNT NEEDED
BUBBLE GUM, FOUR DIFFERENT BRANDS	*Include one sugar free option* Examples: Super Bubble, Hubba Bubba, Bubbleyum, Trident (sugar free)	16 pieces, 4 pieces from each brand
GRAPH PAPER		1 sheet
DOT STICKERS	Four different colors	6 of each color
COLORED PENCILS	Match colors of dot stickers	4 pencils
WHITE VINEGAR		2 cups
ZIPLOC BAG, QUART-SIZE		4 bags
MEASURING CUP, ½ C.		1
WHITE SANDWICH BREAD		1 piece
PERMANENT MARKER		1